CLAIMS

1. A method for cutting a workpiece comprising a substrate formed with semiconductor material, comprising:

placing the workpiece comprising the substrate on a porous member having a mounting surface;

securing the workpiece on the mounting surface by applying suction to the workpiece through pores in the porous member;

cutting the workpiece into individual elements, the elements remaining secured to the mounting surface by the applied suction.

2. The method of claim 1, further comprising:

cutting the workpiece using laser energy.

3. The method of claim 1, further comprising:

cutting the workpiece using laser energy, wherein the laser energy has a wavelength that is absorbed to a greater degree by the workpiece than by the mounting surface.

4. The method of claim 1, further comprising:

reducing the suction to release the elements from the mounting surface; and

removing the elements from the mounting surface.

5. The method of claim 1, further comprising;

after said cutting the workpiece, adhering the elements to a flexible sheet; and

removing the elements adhered to the flexible sheet from the mounting surface.

6. The method of claim 1, further comprising:

after said cutting the workpiece, using a robotic device to remove the elements from the mounting surface.

7. The method of claim 1, wherein the porous member comprises a rigid plate.

8. The method of claim 1, wherein the porous member comprises a flexible sheet.

9. The method of claim 1, wherein the porous member comprises paper.

10. The method of claim 1, wherein the porous member comprises plastic.

11. The method of claim 1, wherein the porous member comprises ceramic.

12. The method of claim 1, wherein the porous member comprises metal.

13. The method of claim 1, wherein the substrate comprises a semiconductor wafer having an active surface, and the active surface is mounted in contact with the mounting surface.

14. The method of claim 1, further comprising;

cutting the workpiece using a solid state laser.

15. The method of claim 1, further comprising;

cutting the workpiece using a solid state UV laser.

16. The method of claim 1, further comprising;

cutting the workpiece using a Q-switched solid state laser.

17. A method for manufacturing laser diodes, comprising:

forming an array of laser diodes on a semiconductor substrate;

placing the substrate on a mounting surface of a porous member;

securing the semiconductor substrate on the mounting surface by applying suction through pores in the porous member; and

cutting the semiconductor substrate into individual elements using laser energy, the elements remaining secured to the mounting surface by the applied suction.

18. The method of claim 17, wherein said forming includes forming a layer of GaN on a sapphire substrate, removing the layer of GaN from the sapphire substrate, and mounting the layer of GaN on the semiconductor substrate.

19. The method of claim 17, wherein the laser energy has a wavelength that is absorbed to a greater degree by the semiconductor substrate than by the mounting surface.

20. The method of claim 17, further comprising:
reducing the suction to release the elements from the mounting surface; and
removing the elements from the mounting surface.

21. The method of claim 17, further comprising;
after said cutting the semiconductor substrate, adhering the elements to a flexible sheet; and
removing the elements adhered to the flexible sheet from the mounting surface.

22. The method of claim 17, further comprising:
after said cutting the semiconductor substrate, using a robotic device to remove the elements from the mounting surface.

23. The method of claim 17, wherein the porous member comprises a rigid plate.

24. The method of claim 17, wherein the porous member comprises a flexible sheet.

25. The method of claim 17, wherein the porous member comprises paper.

26. The method of claim 17, wherein the porous member comprises ceramic.

27. The method of claim 17, wherein the porous member comprises plastic.

28. The method of claim 17, wherein the array is placed in contact with the mounting surface.

29. The method of claim 17, further comprising;
cutting the substrate using a solid state laser.

30. The method of claim 17, further comprising;
cutting the substrate using a solid state UV laser.

31. The method of claim 17, further comprising;
cutting the substrate using a Q-switched solid state laser.

32. A system for separating integrated devices from an array of integrated devices on a semiconductor substrate, comprising:

a laser generating laser energy in a wavelength substantially absorbed by the semiconductor substrate;

a stage adapted to support, and move, the substrate, the stage including a vacuum chuck having a porous mounting surface adapted to secure the semiconductor substrate on the stage by suction through pores in the porous mounting surface;

optics directing the laser energy to impact the semiconductor substrate secured on the stage; and

a control system coupled to the solid state laser and the stage, the control system controlling the laser and stage, and causing the laser energy to impact the semiconductor substrate in a pattern at a rate of motion sufficient to cut kerfs substantially through the substrate in the pattern.

33. The system of claim 32, wherein the vacuum chuck comprises a removable porous member.

34. The system of claim 32, wherein the vacuum chuck comprises a porous member, and the porous member comprises ceramic.

35. The system of claim 32, wherein the vacuum chuck comprises a porous member, and the porous member comprises a flexible, porous sheet.

36. The system of claim 32, wherein the vacuum chuck comprises a porous member, and the porous member comprises porous paper.

37. The system of claim 32, wherein the vacuum chuck comprises a porous member, and the porous member comprises porous plastic.

38. The system of claim 32, wherein the vacuum chuck comprises a porous member, and the porous member comprises porous metal.

39. The system of claim 32, wherein the laser comprises a pulsed laser, and the control system controls a rate of motion of the stage, causing overlap of successive pulses.

40. The system of claim 32, including an edge detection system which detects edges of a substrate mounting on the stage during movement of the stage;

41. The system of claim 32, wherein the control system includes logic to set up said pattern.

42. The system of claim 32, including a video system for viewing a substrate mounted on the stage.

43. The system of claim 32, wherein the control system includes logic to set up parameters including pulse repetition rate, pulse energy and stage speed.

44. The system of claim 32, wherein the laser comprises a Q-switched Nd:YAG laser.

45. The system of claim 32, wherein the laser comprises a Q-switched $Nd:YVO_4$ laser.

46. The system of claim 32, wherein the laser comprises a diode pumped, Q-switched Nd:YVO_4 laser operating at a third harmonic wavelength of about 355 nanometers.

47. The system of claim 32, wherein the laser comprises a diode pumped, Q-switched Nd:YAG laser operating at a third harmonic wavelength of about 355 nanometers.

48. The system of claim 32, wherein the kerfs have a width between about 5 and 15 microns.

49. A system for separating laser diodes from an array of laser diodes on a semiconductor substrate, comprising:

a Q-switched, solid state laser generating pulses of laser energy in a wavelength between about 150 and 560 nanometers, pulse duration less than about 30 nanoseconds and a spot size of less than 25 microns, at a repetition rate of greater than 10 kHz;

a stage adapted to support, and move, the semiconductor substrate, the stage including a vacuum chuck having a porous mounting surface adapted to secure the substrate on the stage by suction through pores in the porous mounting surface;

optics directing the pulses to impact the semiconductor substrate secured on the stage; and

a control system coupled to the solid state laser and the stage, the control system controlling the laser and stage, and causing the pulses to impact the semiconductor substrate in a pattern at a rate of motion causing overlap of successive pulses sufficient to cut kerfs substantially through the substrate.

50. The system of claim 49, wherein the vacuum chuck comprises a removable porous member.

51. The system of claim 49, wherein the vacuum chuck comprises a porous member, and the porous member comprises ceramic.

52. The system of claim 49, wherein the vacuum chuck comprises a porous member, and the porous member comprises a flexible, porous sheet.

53. The system of claim 49, wherein the vacuum chuck comprises a porous member, and the porous member comprises porous paper.

54. The system of claim 49, wherein the vacuum chuck comprises a porous member, and the porous member comprises porous plastic.

55. The system of claim 49, wherein the vacuum chuck comprises a porous member, and the porous member comprises porous metal.

56. The system of claim 49, wherein the control system includes logic to set up said pattern.

57. The system of claim 49, including a video system for viewing a substrate mounted on the stage.

58. The system of claim 49, wherein the laser comprises a Q-switched Nd:YAG laser.

59. The system of claim 49, wherein the laser comprises a Q-switched Nd:YVO_4 laser.

60. The system of claim 49, wherein the laser comprises a diode pumped, Q-switched Nd:YAG laser operating at a third harmonic wavelength of about 355 nanometers.

61. The system of claim 49, wherein the laser comprises a diode pumped, Q-switched Nd:YVO_4 laser operating at a third harmonic wavelength of about 355 nanometers.

62. The system of claim 49, wherein the kerfs have a width between about 5 and 15 microns.

63. The system of claim 49, wherein the overlap is in a range from 50 to 99 percent.

64. The system of claim 49, wherein the pulse rate is between about 20 kHz and 50 kHz.

65. The system of claim 49, wherein said energy density is between about 10 and 100 joules per square centimeter, said pulse duration is between about 10 and 30 nanoseconds, and the spot size is between about 5 and 25 microns.

66. The system of claim 49, wherein the substrate includes an integrated circuit.

67. A method for manufacturing die from a substrate comprising a material, comprising;

mounting the substrate on a stage;

directing pulses of laser energy at a surface of the substrate, the pulses having a wavelength, an energy density, a spot size, a repetition rate and a pulse duration sufficient to induce ablation of said material;

causing the pulses to impact the substrate in a scribe pattern to cut scribe lines in the substrate; and

controlling polarization of the laser pulses with respect to direction of scribe lines in the scribe pattern.

68. The method of claim 67, wherein the wavelength is less than about 560 nanometers.

69. The method of claim 67, including using a solid state UV laser to generate the pulses.

70. The method of claim 67, wherein the scribe pattern includes scribe lines parallel to first and second axes, including controlling the polarization so that the

polarization is linear and arranged in a first direction for scribe lines parallel to the first axis and arranged in a second direction for scribe lines parallel to the second axis.

71. The method of claim 67, including separating die defined by the scribe pattern.

72. The method of claim 67, including causing overlap of successive pulses.

73. The method of claim 67, wherein the wavelength is between about 150 and 560 nanometers.

74. The method of claim 67, wherein the repetition rate is between about 10 kHz and 50 kHz.

75. The method of claim 67, wherein said energy density is between about 10 and 100 joules per square centimeter, said pulse duration is between about 10 and 30 nanoseconds, and the spot size is between about 5 and 25 microns.

76. The method of claim 67, wherein the substrate has a thickness, and the scribe lines are cut to a depth of more than about one half said thickness.

77. The method of claim 67, wherein the spot size is between 5 and 15 microns.

78. The method of claim 67, including causing overlap of successive pulses, and wherein the overlap is in a range from 50 to 99 percent.

79. The method of claim 67, wherein the substrate has an active surface and a back side, and including causing the laser pulses to impact the back side.

80. The method of claim 67, wherein the stage comprises a movable x-y stage, and said causing the pulses to impact the substrate in a scribe pattern, includes moving the substrate on the x-y stage.

81. The method of claim 67, wherein said controlling polarization includes aligning polarization of the pulses parallel to the scribe line being scribed.

82. The method of claim 67, wherein said material comprises a semiconductor.